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# Determining the level of sleepiness in the American population and its correlates

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ABSTRACT

*Objective:* To assess the prevalence, to determine the risk factors and to evaluate the impacts of excessive sleepiness in the general population.
*Method:* It is a cross-sectional telephone study using a representative sample consisting of 8937 non-institutionalized individuals aged 18 or over living in Texas, New York and California. They represented a total of 62.8 million inhabitants. The participation rate was 85.6% in California, 81.3% in New York and 83.2% in Texas. Interviews were managed by the Sleep-EVAL expert system. The questionnaire included questions on sleeping habits, life habits, health, DSM-IV mental disorders, DSM-IV and ICSD sleep disorders.
*Results:* As many as 19.5% of the sample reported having moderate excessive sleepiness and 11.0% reported severe excessive sleepiness. Moderate excessive sleepiness was comparable between men and women but severe excessive sleepiness was higher in women (8.6% vs. 13.0%). Factors associated with moderate excessive sleepiness were sleeping 6 h or less per main sleep episode (OR:2.0); OSAS (OR:2.0); insomnia disorder (OR:2.4); Restless Legs Syndrome (OR: 1.8) major depressive disorder (OR: 1.7); anxiety disorder (OR:1.5) and use of tricyclic antidepressant (OR: 2.1) presence of heart disease (OR: 1.5), cancer (1.8) and chronic pain (1.3). Factors associated with severe excessive sleepiness were similar with the addition of being a woman (OR:1.5), alcohol dependence (OR: 1.4), bipolar disorder (OR: 2.1), use of over-the-counter sleeping pills (OR: 2.5), narcotic analgesics (OR: 3.4), Antidepressants (other than SSRI or tricyclic) and presence of gastro-esophageal reflux disease (OR:1.6). Sleepy individuals were twice as likely than non-sleepy participants to have had accidents while they were at the wheel of a vehicle during the previous year.
*Conclusions:* Excessive sleepiness is highly prevalent in the American population. It was strongly associated with insufficient sleep and various sleep disorders as well as mental and organic diseases.


## 1. Introduction

The problem of excessive sleepiness has gained greater awareness in the past two decades, as illustrated by the increasing number of epidemiological studies examining its prevalence in the general population. Yet, comparability between these studies remains hazardous: Few of them have used similar definitions to measure excessive sleepiness. Some studies have used a frequency criterion while others have used a severity criterion, which leads to different figures (Ohayon, 2008). Therefore, reported prevalences have ranged from a low of 3.9% (Rockwood et al., 2001) to a high of 32% (Asplund, 1996). There is still little information regarding associated factors with daytime sleepiness. Some epidemiological studies have reported an association with poor sleep hygiene (Hublin et al., 1996; Ohayon et al., 1997), work conditions (Ohayon et al., 1997, 2010a, 2010b), psychotropic medication (Hublin et al., 1996; Ohayon et al., 1997; Nugent et al., 2001), sleep-disordered breathing (Ohayon et al., 1997; Hublin et al., 1996; Nugent et al., 2001; Bixler et al., 2005), psychiatric disorders (Ford and Kamerow, 1989; Breslau et al., 1996; Hublin et al., 1996; Ohayon et al., 1997) and physical illnesses (Hublin et al., 1996; Ohayon et al., 1997; Nugent et al., 2001).

Unlike insomnia, excessive sleepiness is not a diagnosis; it can be an essential or an associated symptom of a sleep disorder such as for hypersomnia and obstructive or central sleep apnea syndrome. Or, it can be a consequence of a sleep disorder such as for insomnia. However, implications for individuals with excessive sleepiness can be dramatic; only a few seconds of lack of concentration may be enough to injury oneself or someone else. Surprisingly, almost no epidemiological studies have questioned the participants about the impact of excessive sleepiness on their daytime functioning.

The present study aims: 1) to assess the prevalence of excessive sleepiness in the general population of three of the most populated

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U.S. states: California, New York and Texas; 2) to examine the associations between excessive sleepiness, mental disorders, sleep disorders and organic illnesses; 3) to determine the risk factors for excessive sleepiness and 4) to evaluate the impacts of excessive sleepiness on daytime functioning and help-seeking behaviors.

## 2. Methods

### 2.1. Sample

The study has been ongoing since 2003 (Ohayon et al., 2010b). The target population was individuals aged 18 years and older living in the states of California, New York and Texas (USA). A total of 8937 individuals were interviewed by telephone. They were representative of the general population of these three states (3243 subjects in California, 3445 subjects in New York and 2249 subjects in Texas). These three states represented a total of 62.8 million inhabitants. The participation rate was 85.6% in California, 81.3% in New York and 83.2% in Texas. The sample used in this study is the first wave of a longitudinal cohort currently in its fourth wave.

### 2.2. Procedures

In the first stage, telephone numbers were randomly selected proportionally to the population size of each county in California, New York and Texas. The selection was done within each state using a computerized residential phone book. In the second stage, during the telephone contact, the Kish method (Kish, 1965) was used to select one respondent per household. This method allowed for the selection of a respondent based on age and gender to maintain a sample representative of these two parameters. If the household member chosen declined to participate, the household was dropped and replaced with another number from the same area, and the process was repeated.

Interviewers explained the goals of the study to potential participants. They requested verbal consent before conducting the interview. The participants had the option of calling the principal investigator if they wanted further information. The study was reviewed by the Stanford University Institutional Review Boards (IRB).

Excluded from the study were subjects who were not fluent in English (or Spanish), who suffered from a hearing or speech impairment or who had an illness that precluded them from being interviewed. Phone numbers were dropped and replaced only after a minimum of 10 unsuccessful dial attempts were made at different times and on different days, including weekends. An added-digit technique; that is, increasing the last digit of a number by one, was employed to control for unlisted telephone numbers. The final sample included 21.4% unlisted telephone numbers.

The interviews lasted on average 74.5 ($\pm$37.8) min. An interview could be completed with more than one telephone call when it exceeded 60 min or at the request of the participant. Participants answered an average of 308 questions. The shortest interviews had 110 questions and the longest had 630 questions. The project manager or the team leaders also called nearly all the participants who completed the interview. During this 6–8 min call, they asked a series of random questions related to the interview and also asked the participants how satisfied they were with the interviewer. Interviewers were supervised by two or three team leaders with a ratio of one team leader for every 6 interviewers.

## 3. Instrument

Interviewers used the Sleep-EVAL knowledge-based expert system (Ohayon, 1994, 1999) to conduct the interviews. This computer software is specially designed to administer questionnaires and conduct epidemiological studies in the general population.

The system is composed of a non-monotonic, level-2 inference engine, two neural networks, a mathematical processor, the knowledge base and the base of facts. Simply put, the interview begins with a series of questions asked of all the participants. Questions were read aloud by the interviewer as they appeared on the screen. These questions were either closed-ended (e.g., yes/no, five-point scale, multiple choice) or open-ended (e.g., duration of symptom, description of illness).

Once this information was collected, the system began the diagnostic exploration of mental disorders. On the basis of responses provided by a subject to this questionnaire, the system formulated an initial diagnostic hypothesis that it attempted to confirm or reject by asking supplemental questions or by deductions. Concurrent diagnoses are allowed in accordance with the DSM-IV (APA, 2000) and the Classification of Sleep Disorders or ICSD (AASM, 1997). The system terminated the interview once all diagnostic possibilities were exhausted.

The differential process is based on a series of key rules allowing or prohibiting the co-occurrence of two diagnoses. The questionnaire of the expert system is designed such that the decision about the presence of a symptom is based upon the interviewee's responses rather than on the interviewer's judgment. This approach has proved to yield better agreement between lay interviewers and psychiatrists on the diagnosis of minor psychiatric disorders (Lewis et al., 1992). The system has been tested in various contexts, in clinical psychiatry and sleep disorders clinics (Ohayon, 1995; Ohayon et al., 1999).

## 4. Variables

Sleepiness was assessed according to its severity (on a five-point scale ranging from not at all to extremely), frequency in a day, frequency in a week, moment of the last episode, period in the day when sleepiness occurred, situations and intensity when sleepiness occurred (at work, during daily activities, at school, when visiting friends or relatives, during a conversation, in quiet situations (watching TV, reading, relaxing), as a car passenger, as a driver, when using public transportation), evolution of excessive sleepiness since it first appeared, medical consultation related to sleepiness and impacts of sleepiness on daytime functioning.

### 4.1. Other variables included

Sociodemographic information: age, gender, race, marital status, occupation, education level, number of children, income.

Medical information: 1) Consultations in the previous year: number and specialty of consulted physician(s); 2) Hospitalizations in the previous year: number, duration and motives; 3) Description of illnesses; 4) Medications and indications; 5) Pain: sites of pain; frequency, intensity and duration; treatment; causes of pain; 6) Menopausal status for women; 7) Health quality; 8) Weight, height, blood pressure; 9) Medical insurance.

Life habits: use and quantity of alcohol, drugs (other than medication), tobacco and caffeine; frequency of physical exercise.

Mental disorder diagnoses were assessed according to DSM-IV classification respecting positive and differential diagnosis processes. Sleep disorders were assessed according to the DSM-IV and ICSD classifications. ICD-10 was used for the classification of organic diseases.